HP
P4000 Multi-Site HA/DR Solution Pack User Guide

Abstract

This guide contains detailed instructions for designing and implementing the Multi-Site SAN features of the HP P4000 SAN Solution. The Multi-Site SAN features enable you to synchronously and automatically mirror data between geographic sites. Topics include designs for network configurations and instructions about implementing the network designs. The intended audience is system administrators who manage HP P4000 SAN solutions.

For the latest version of this guide, see the HP website http://www.hp.com/support/manuals.

HP Part Number: AX696-96074
Published: September 2011
Edition: 5

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1 Designing a Multi-Site SAN

The Multi-Site SAN features enable you to synchronously mirror data between sites automatically. You create a Multi-Site SAN by configuring equal numbers of storage systems into sites in the software. The Multi-Site SAN software enables a variety of features that are based on geographic awareness and synchronous replication:

- Multi-Site clusters that can:
  - Span up to three sites
  - Span multiple subnets
  - Have multiple VIPs
- Geographical awareness, enabled by designating storage systems as members of a particular site.
- Synchronously replicated (mirrored) data between sites, based on volume data protection level.
- Site information that ensures that data is mirrored between sites for high availability and disaster recovery.
- I/O path preferencing, so that application servers connect to storage systems located in the same site.
- Failover Manager support for automatic failover/failback in three-site configurations without requiring a physical storage system in the third site.
- Failover Manager for quorum management if the network connection between the two sites becomes unavailable.
- Recover quorum via CLI when a site failure also results in losing quorum in the management group.

Failover Manager overview

The Failover Manager is a specialized version of the SAN/iQ software, designed to run as a virtual appliance in a VMware environment. The Failover Manager participates in the management group as a real manager in the system; however, it performs quorum operations only, not data movement operations. It is especially useful in a Multi-Site SAN configuration to manage quorum for the multi-site configuration without requiring additional physical hardware at a site.

The Failover Manager is supported on VMware Server, Workstation, and Player. For detailed information about installing and configuring the Failover Manager, see "Using Specialized Managers" in the *HP P4000 SAN Solution User Guide*.

Requirements

- A Multi-Site SAN requires a feature key for each storage system in the management group that is also participating in a Multi-Site cluster.
- All sites must have the same number of storage systems. Storage systems must be added to or removed from Multi-Site clusters equally.

Designing a Multi-Site SAN

The Multi-Site SAN software offers multiple features and the design flexibility to protect against certain types of failures in the environment.

Data replication, site design, and quorum managers combine to protect against certain types of failures in the environment. Some of the common types of failures a Multi-Site SAN protects against include data center failures and storage system failures:

Data center failures

- Site power outage
- Site network outage
- Site disaster (fire, flood, terrorist attack, and so forth)

Individual storage system failures

- Power outage
- Network outage
- System disaster
- System failure (backplane, motherboard, RAM, CPU)

Configuring data replication for optimal availability and redundancy

The SAN/iQ software offers six levels of synchronous replication at a volume level. In order to protect the data across sites, you must choose a data protection level with a number of mirrors that is at least equal to the number of sites in the configuration. For instance, if the storage cluster spans three sites, then volumes must be configured as Network RAID–10+1 in order to insure that data is the same on each site.

NOTE: Network RAID-0, Network RAID-5, and Network RAID-6 will not tolerate site failures.

"Data protection levels and the supported number of sites" (page 5) describes the data replication levels for the Multi-Site SAN and associated supported configurations.

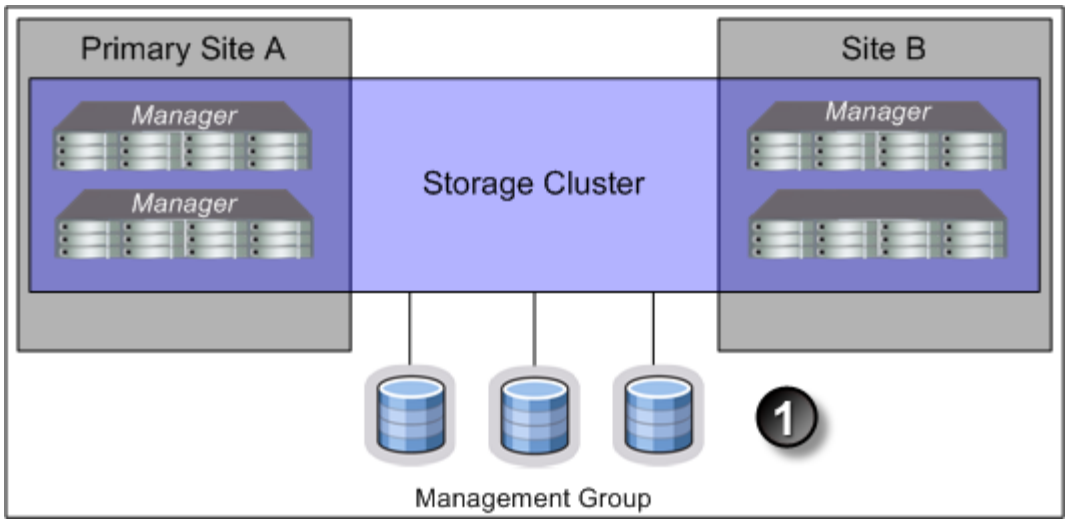
Table 1 Data protection levels and the supported number of sites

Data protection level	Number of sites supported
Network RAID-10	2
Network RAID–10+1	3 **NOTE:** 2 sites are supported, but not considered a best practice configuration
Network RAID–10+2	2 **NOTE:** 3 sites are supported, but are not considered a best practice configuration

When to use Network RAID-10+2

Using Network RAID-10+2 offers a level of data protection that enables the Multi-Site SAN to sustain a complete failure at one site and still maintain replicated data at the other site. For instance, with Network RAID-10+2 there are four copies of data for the volume on the SAN. In a two-site configuration, the Multi-Site SAN software puts two of the four copies in one site and the remaining two in the other. If a site fails, the remaining site still has two copies and remains fault-tolerant.

Figure 1 Sample configuration for two-site, data protection level Network RAID-10+2



1. Volumes are configured with Network RAID-10+2

Configuring sites and quorum managers to achieve optimal high availability and redundancy

Several recommended site configurations can be used with the Multi-Site SAN software. These configurations provide varying levels of availability and redundancy. "Common configurations of Multi-Site SANs and mangers" (page 7) shows the recommended configurations. Select the one that best matches your environment.

In addition to setting up the Multi-Site clusters for data replication, it is important to set up the SAN managers for quorum correctly to ensure that in the event of a failure the system can be properly recovered. Maintaining quorum can be either an automated process or manually recovered by an Administrator. Table 2 (page 7) summarizes common Multi-Site SAN and manager configurations.

Table 2 Common configurations of Multi-Site SANs and mangers

Number of sites	Cluster/site setup	Total number of managers of all types	Failover Manager	Site types
three physical sites	Cluster spans two sites	Min = three; Max = five	In the third site	All sites are peer.
two physical sites, with logical third site	Cluster spans two sites	Min = three; Max = five	In the logical third site	All sites are peer.
three physical sites	Cluster spans three sites	Min = three; Max = six	Not used	All sites are peer.
two physical sites	Cluster spans two sites	Min = three; Max = five	Not used	One site is designated primary.

Best practice

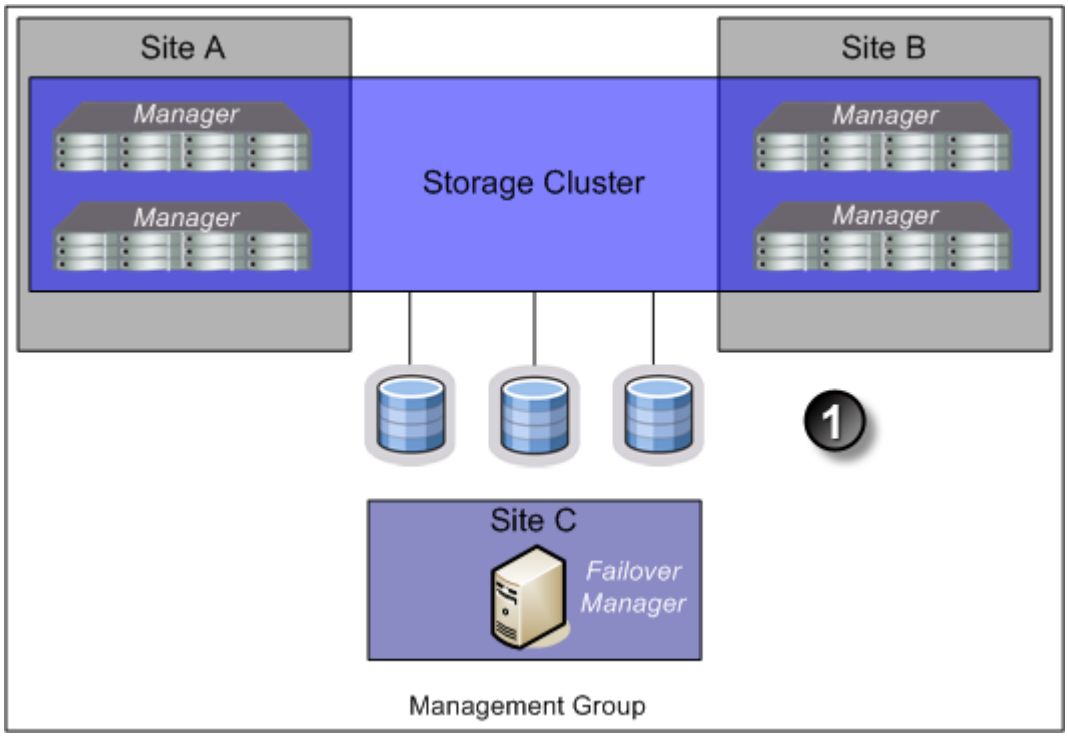
In a cluster that spans multiple sites, run the same number of managers in each site. In a cluster that spans two sites, run a Failover Manager in a third site (physical or logical) that is not included in the cluster ("Three physical sites: cluster spans two sites, Failover Manager in third site" (page 8)). The one exception to this rule is the two-site configuration in which one site is configured as primary ("Two physical sites: cluster spans two sites, one site is the primary site" (page 9)). In this case, run a majority of the managers in the primary site.

Sample configurations

The following diagrams illustrate best practice for four different configurations:

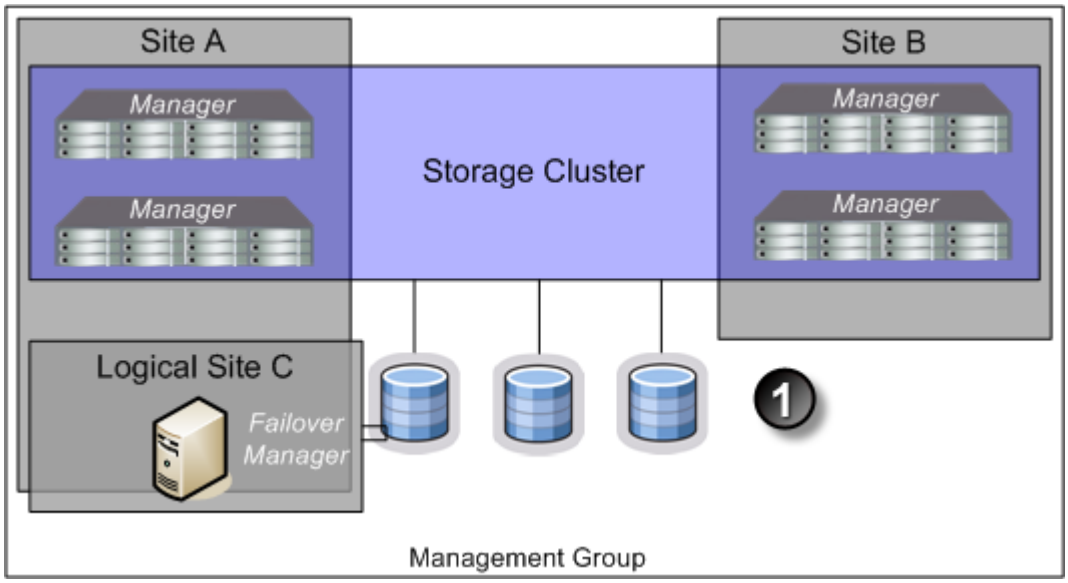
- "Three physical sites: cluster spans two sites, Failover Manager in third site" (page 8)
- "Two physical sites, logical third site: cluster spans two sites, Failover Manager in logical third site" (page 8)
- "Three physical sites: cluster spans three sites" (page 9)
- "Two physical sites: cluster spans two sites, one site is the primary site" (page 9)

Figure 2 Three physical sites: cluster spans two sites, Failover Manager in third site



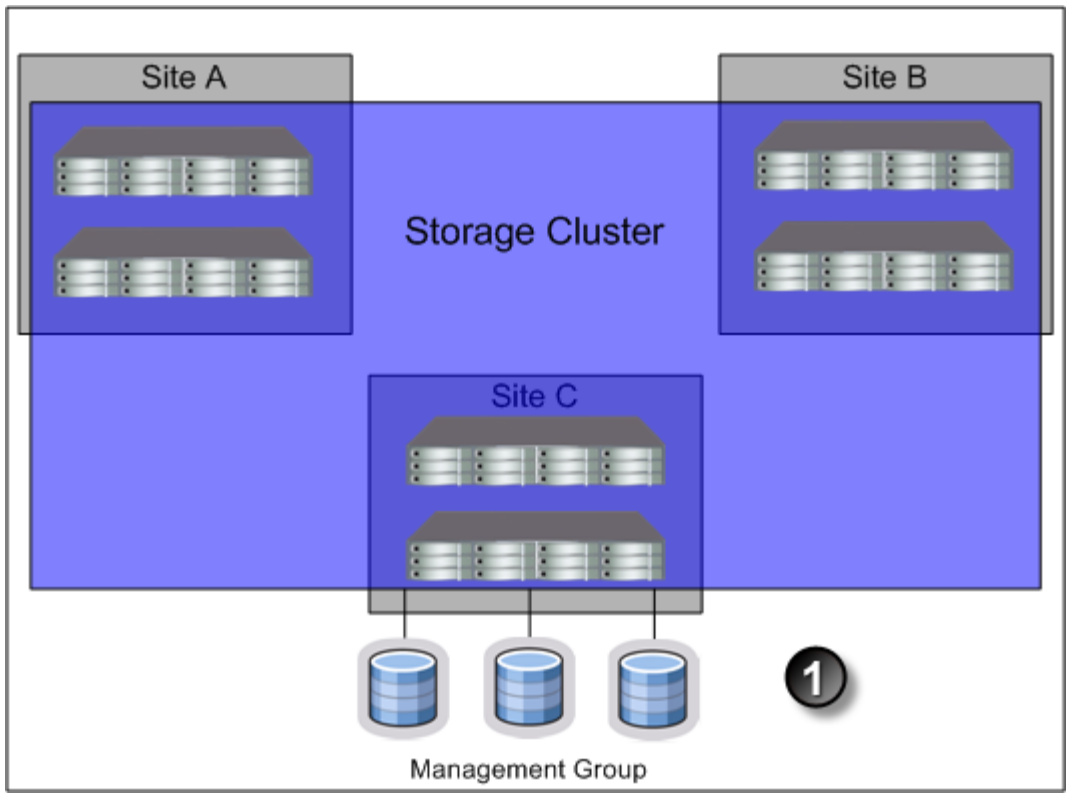
1. Volumes are configured with Network RAID-10

Figure 3 Two physical sites, logical third site: cluster spans two sites, Failover Manager in logical third site



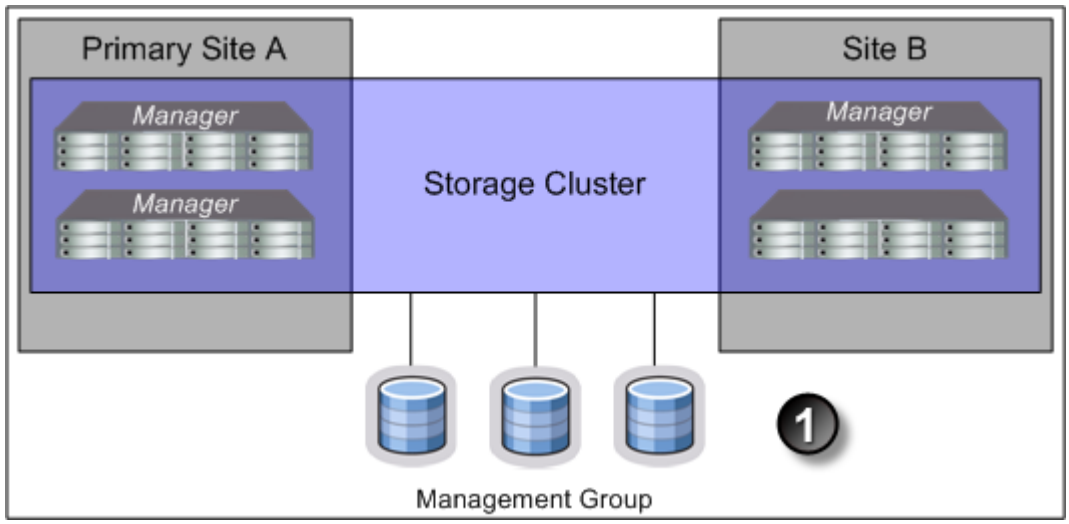
1. Volumes are configured with Network RAID-10

Figure 4 Three physical sites: cluster spans three sites



1. Volumes are configured with Network RAID-10+1

Figure 5 Two physical sites: cluster spans two sites, one site is the primary site



1. Volumes are configured with Network RAID-10

Alternative setups

The Multi-Site SAN software supports many other valid configurations than the four illustrated in the prior section."Alternative Multi-Site SAN configurations " (page 10) lists other possible configurations.

Table 3 Alternative Multi-Site SAN configurations

Alternate configuration	Description	Details
More than one Multi-Site cluster in the management group	Multiple clusters running within the same management group.	The Multi-Site SAN software supports running many clusters in the same management group. You simply need to make sure that clusters have the same number of storage systems in each site for that particular cluster.
More than three sites	There are more than three sites in the cluster.	A particular cluster can only span up to three sites. However, the Multi-Site SAN software supports having more than one cluster. The different clusters can span different sites within the same cluster.
Using Virtual Manager	The Virtual Manager capability remains in the product (a manual process for recovering quorum).	The Virtual Manager is used in two-site configurations, and is not as commonly used as the Failover Manager. For more information about the Virtual Manager, see the chapter "Special Managers" in the *HP P4000 SAN Solution User Guide*.
Using Remote Copy with Multi-Site SAN	The cluster contains Remote Copy, which like all other SAN/iQ features, is compatible with Multi-Site SAN.	You can use Remote Copy to replicate data from a Multi-Site SAN to a Disaster Recovery or Backup site. See the chapter "Understanding and Planning Remote Copy" in the *Remote Copy User Manual*.
Multiple subnet clusters in the same site	The Multi-Site SAN features can be used to set up clusters that span multiple subnets in the same site.	The Multi-Site SAN software can be used to create clusters that span multiple networks (subnets) in larger Enterprise data centers. The storage systems all reside in the same site. However, the cluster must be Multi-Site if it is to contain storage systems from different subnets.

Designing the network for the Multi-Site SAN

Good network design is a critical part of setting up a Multi-Site SAN that meets your needs. A good Multi-Site SAN network encompasses the following attributes:

- Reliability
- High availability
- High performance

This section contains information about the minimum recommended network design considerations when planning a network to support a Multi-Site SAN.

Best practices for implementing the Multi-Site SAN network

- Adequate bandwidth—Plan for 50 MB/sec of bandwidth for each storage system in each site. For instance, if each site contains five storage systems, then you need 250 MB/sec throughput. In this case, that translates into two Gigabit Ethernet links, or more.
- Low round-trip latency—In order to not impact disk I/O to the application server, the round-trip latency between the sites must be no more than 2 ms.
- Redundant links—Have multiple physical connections (media) between the sites for redundancy. The network should be configured so that a link failure does not cause the Multi-Site SAN to go offline.

- Assign servers to sites—Avoid high-latency connections by assigning application servers to the site where the server is located. Application servers assigned to a site connect only to storage systems in the same site as follows:
  - Without MPIO—With servers set up in the CMC with the load balancing option, the system sets up the iSCSI session only to storage systems assigned to the same site.
  - With MPIO and the HP DSM—The system sets up iSCSI sessions only to storage systems assigned to the same site.
  - With MPIO and the Microsoft DSM—With servers set up in the CMC with the load balancing option, the system sets up the iSCSI session only to storage systems assigned to the same site.
- Use the Failover Manager—Unless you have storage systems in three physical sites, use a Failover Manager. Put the Failover Manager in the third site (physical or logical) located on a network that is isolated from the other sites and has a different power connection.

Common Multi-Site SAN network designs

Based on the Multi-Site SAN configuration, there are many network designs that can be implemented that solve the redundancy, high availability, and performance requirements for the Multi-Site SAN. A few commonly used designs are:

- Dual redundant links between the sites
- Full-mesh triangular (three) redundant links between sites
- Hub and spoke central network core with redundant links out to each site
- Combination full-mesh core network with triangular (three) links between sites

Balancing the requirements for high availability during certain types of failures in the Multi-Site SAN and the budget associated with the network infrastructure typically dictates the network architecture a customer will choose to implement. Obviously, the most redundant network typically will cost the most to implement. However, not implementing redundancy in the Multi-Site SAN network significantly curtails the benefits of the Multi-Site SAN software. "Common Multi-Site network configurations and failure protection of each" (page 11) shows the common Multi-Site network configurations and the types of failures against which they provide protection.

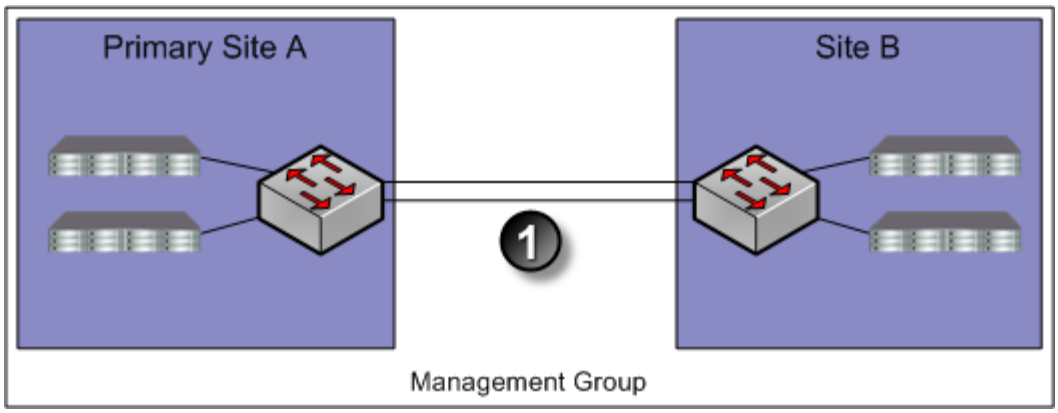
Table 4 Common Multi-Site network configurations and failure protection of each

Network topology	Site failure protection	Network failure protection	Storage system failure protection
Dual redundant links between sites	Yes, with manual intervention	Yes	Yes
Full-mesh triangular links between sites	Yes	Yes	Yes
Hub & spoke central core	Yes	Yes, so long as the core does not fail	Yes
Combo full-mesh core with triangular links between sites	Yes	Yes	Yes

Sample recommended network configurations for Multi-Site SANs

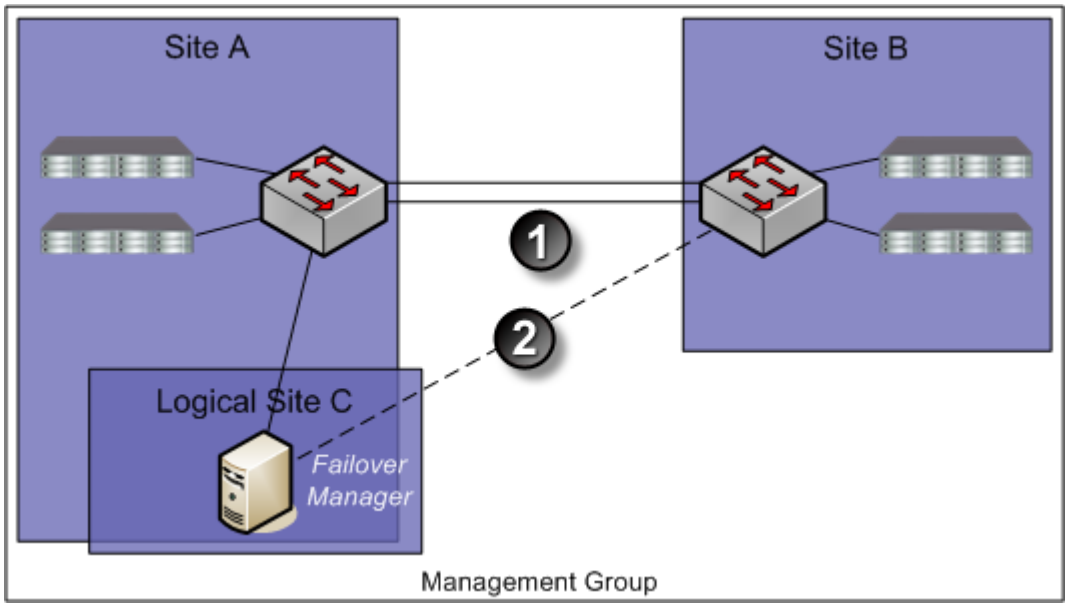
Samples of common network configurations for the topologies described in "Common Multi-Site network configurations and failure protection of each" (page 11) are illustrated in this section. The clusters and sites can have many more storage systems than are depicted here. However, the pictures are more focused on the network design.

Figure 6 Dual redundant links between two sites



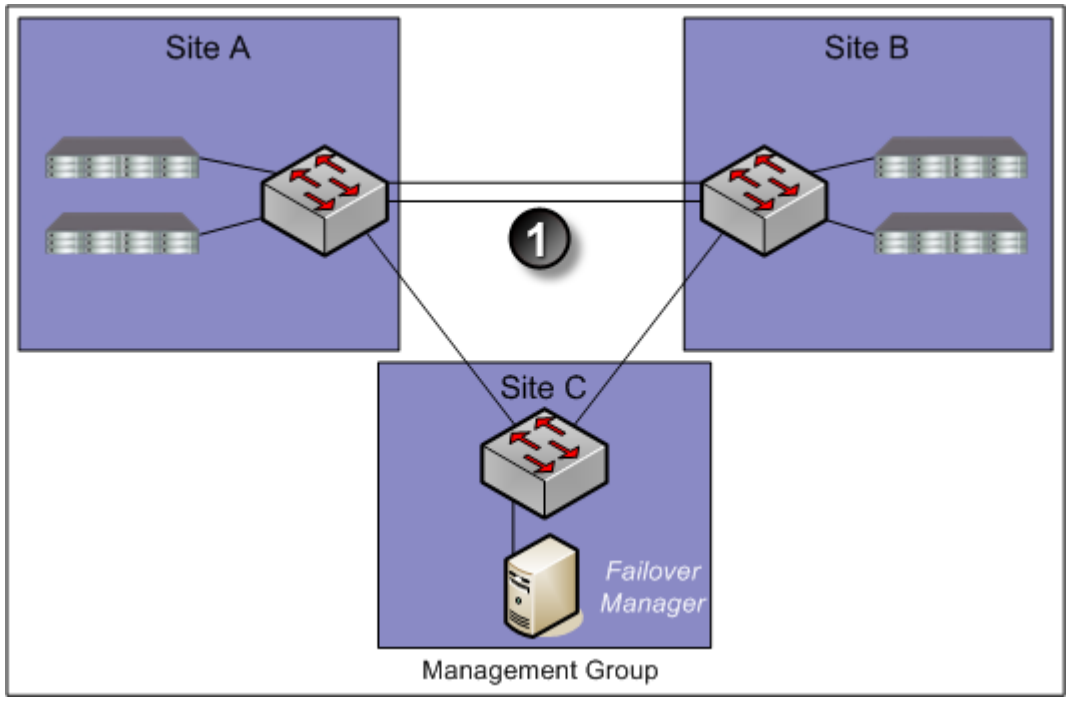
1. Dual redundant GigE links

Figure 7 Dual redundant links between two sites with Failover Manager in logical third site



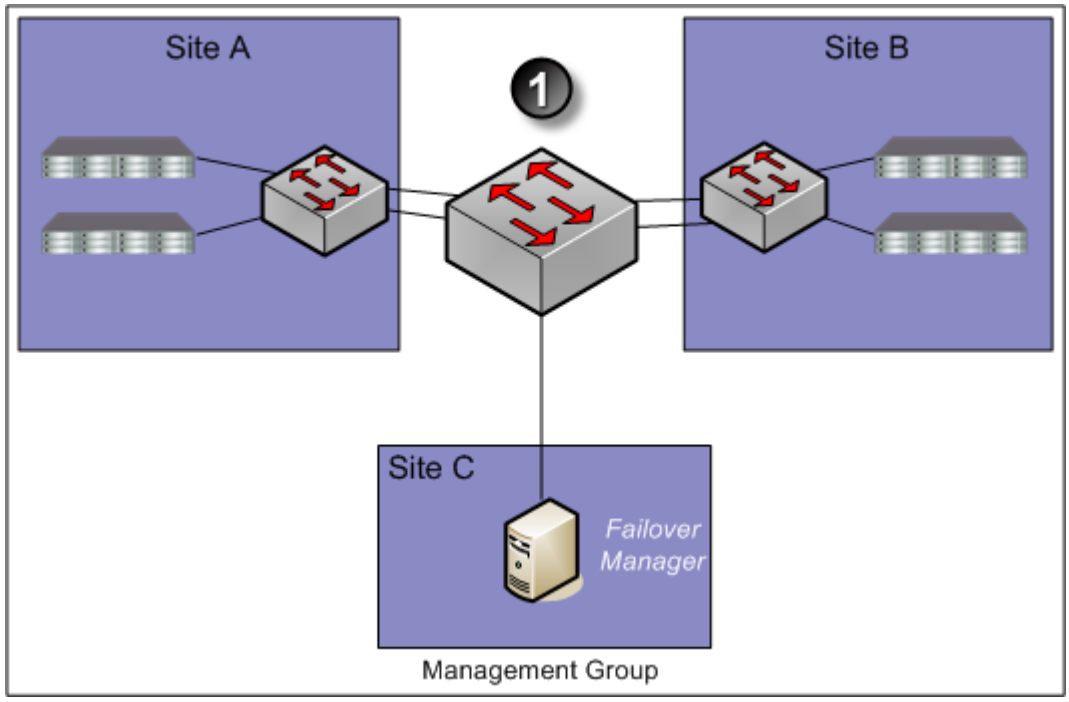
1. Dual redundant GigE links
2. Optional redundant path

Figure 8 Triangular network with Failover Manager



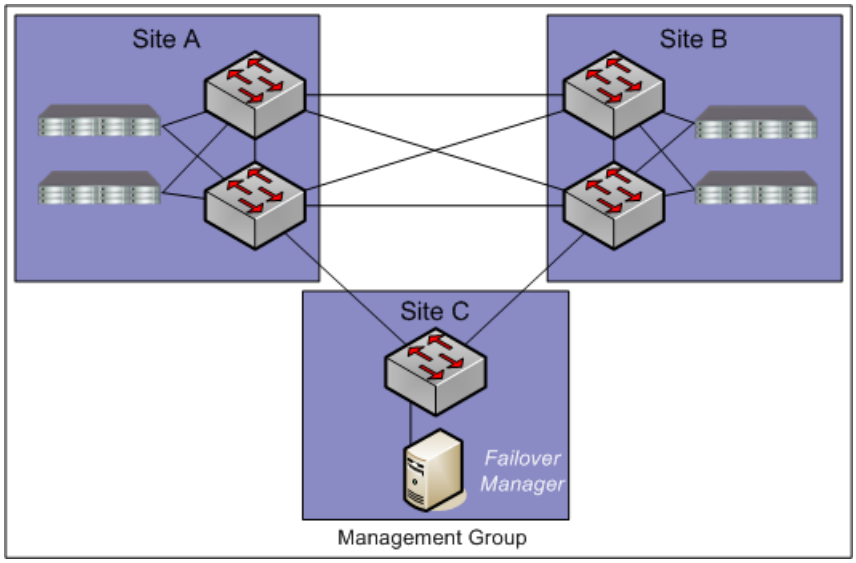
1. Dual redundant GigE links

Figure 9 Hub and spoke network core with redundant links out to each site



1. Core network hub and spoke

Figure 10 Combination full-mesh core with triangular links to all sites



1. Full mesh core network

Using multiple subnets

You can use multiple subnets with a Multi-Site SAN. Multiple subnets let you have multiple VIPs, one VIP per subnet. The advantage of using multiple VIPs is that you can connect to a volume without having to leave the local subnet.

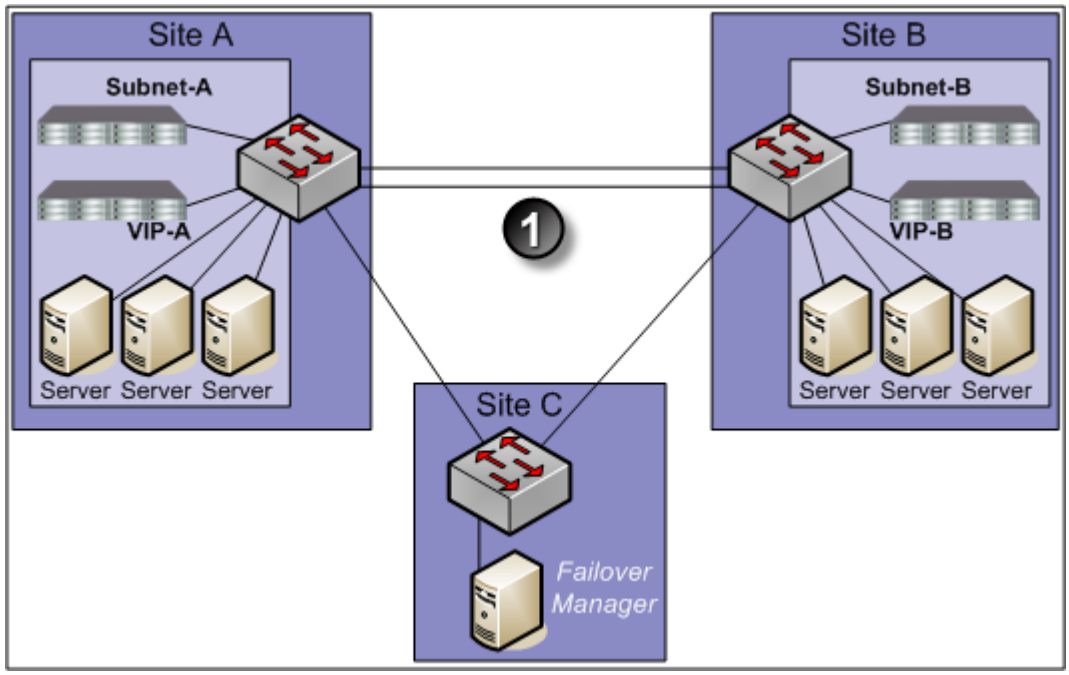
Alternatively, you can assign an application server to a site. Application servers assigned to a site connect only to storage systems in the same site. For more information, see "Best practices for implementing the Multi-Site SAN network" (page 10).

If you use multiple subnets within the iSCSI cluster and implement one subnet per site, you can take advantage of the following Multi-Site SAN features:

- One Virtual IP address per site. iSCSI discovery sessions are terminated on a storage system that is local to the application server in that site.
- Virtual IP addresses are hosted only on storage systems that reside in the same subnet as the VIP.
- Read and Write I/O requests are forwarded from the application server to a storage system that is in the same site as the server. This ensures that the I/O path is optimal and multiple network hops across the network link between the sites are eliminated.

"Multi-Site SAN mapping to subnets, VIPs, and application servers" (page 15) shows an example of how the Multi-Site SAN setup maps to subnets, VIPs, and application servers.

Figure 11 Multi-Site SAN mapping to subnets, VIPs, and application servers



1. Dual redundant GigE links

Connecting volumes to multiple subnets in a Multi-Site SAN using the Microsoft iSCSI initiator

Connecting to volumes in a multiple subnet configuration is similar to connecting to volumes in a single-site configuration, with the following important differences:

- You must configure all cluster VIPs for discovery, for proper failover/failback configuration of a Multi-Site SAN. List the VIPs in the preferred order of connection. For example, if Site A is the first preference for connection, put the VIP associated to Site A first in the discovery list.
- You must also log on to the volumes with the default Target Portal setting.

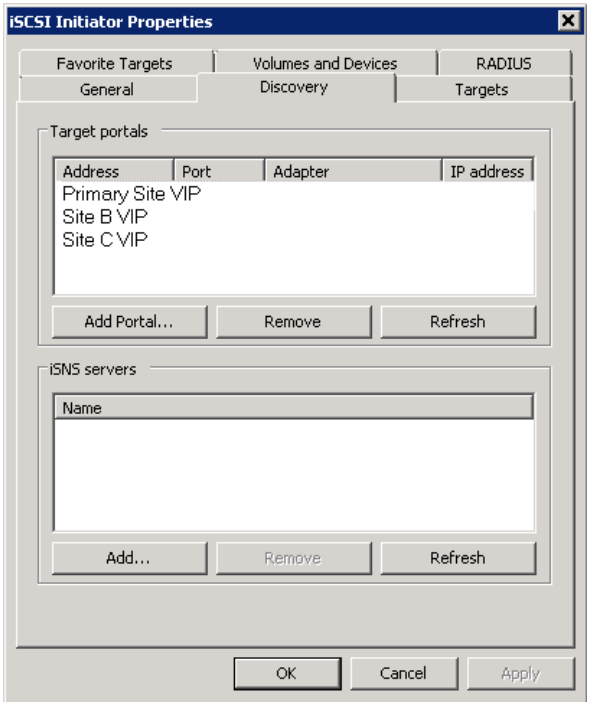
Using multiple cluster VIPs when connecting to a Multi-Site SAN

Use the Virtual IP address of the HP P4000 SAN Solution cluster when connecting to volumes. In a multiple subnet configuration, you must enter both of the VIPs of the multi-site cluster on all the application servers. In addition, all the application servers must have the VIPs listed in the same order. A sample Multi-Site SAN configuration is shown in Figure 12 (page 16). In this configuration, the cluster has three sites: Site A, Site B, and Site C. Site A is primary.

Connecting application servers with single or multiple NICs to a Multi-Site SAN

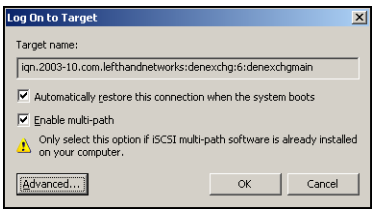
1. On each application server, enter the cluster VIPs in the same order as on the Discovery tab of the iSCSI Initiator Properties window.

Figure 12 Entering VIPs in a Multi-Site SAN configuration



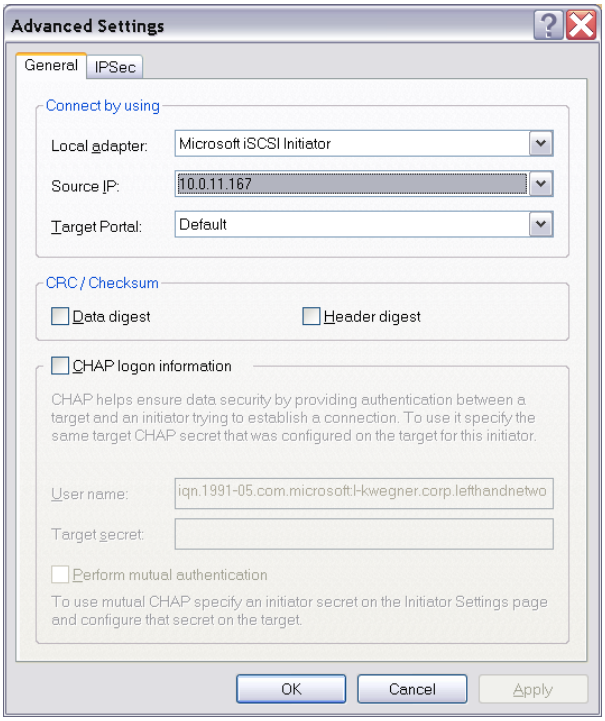
2. On the Targets tab, select the volume to log on to.
3. Click **Log On**.
4. Select the **Enable multi-path** check box if using MPIO.

Figure 13 Logging on to volume



5. [Optional] If you want this volume to be available after rebooting, select the **Automatically restore...** check box.
6. Click **Advanced** to open the Advanced Settings window.
7. Configure the Advanced Settings as follows:
   - For Local adaptor, select **Microsoft iSCSI initiator**.
   - For Source IP, select the IP address of the storage NIC to connect to the volume.
   - For Target portal, leave as Default so that the Discovery list of VIPs is used in the same order on all storage systems.

Figure 14 Target portal value remains Default


Advanced Settings
General
IPSec
Connect by using
Local adapter:
Microsoft iSCSI Initiator
Source IP:
10.0.11.167
Target Portal:
Default
CRC / Checksum
Data digest
Header digest
CHAP logon information
CHAP helps ensure data security by providing authentication between a target and an initiator trying to establish a connection. To use it specify the same target CHAP secret that was configured on the target for this initiator.
User name:
iqn.1991-05.com.microsoft:l-kwegner.corp.lefthandnetwo
Target secret:
Perform mutual authentication
To use mutual CHAP specify an initiator secret on the Initiator Settings page and configure that secret on the target.
OK
Cancel
Apply

8. After setting the values, click **OK** to close the Advanced Settings dialog.
9. Click **OK** again to finish logging on.
10. If you want to set the MPIO load balancing policy, see the *HP P4000 DSM for MPIO Deployment Guide*.
11. If you have multiple NICs, repeat steps 1 through 10 for the additional NICs.

Using MPIO with multiple subnets

When you are using multiple subnets in a Multi-Site SAN, the HP P4000 DSM for MPIO or Microsoft DSM will only build I/O paths to the storage systems that are in the same subnet as the application server. See the *DSM for MPIO Deployment Guide* for more information about MPIO.

When using VMware ESX 4 or higher and its native MPIO in a Multi-Site SAN, you cannot configure more than one subnet and VIP. Multiple paths cannot be routed across subnets by the ESX/ESXi 4 initiator. With VMware ESX, the preferred configuration is a single subnet and with ESX servers assigned to sites in SAN/iQ.

Setting up application clusters in a Multi-Site SAN environment

Just as you can set up a Multi-Site SAN for data availability even when a complete site is offline, you can set up application clusters (Microsoft Cluster Server, VMware ESX Cluster, Linux Cluster, and so forth) so that the cluster nodes are split between the sites. By having the automated failover/failback capabilities in the SAN, many application cluster technologies can leverage this capability to do “stretch” application clustering. Consult the application server specific information for information about setting up clustering to support this type of failover. In general, you must perform three tasks:

1. Set up an application server node in each site.
2. Configure the application server to connect to the volumes on the SAN.
3. If using multiple subnets in the storage cluster, log on to both VIPs in the cluster.

If you are using the HP P4000 DSM for MPIO, see the *DSM for MPIO Deployment Guide*.

Using the Primary Site designation in two-site configurations

The Multi-Site SAN software supports designating a particular site as Primary so that it does not go offline when the secondary site goes offline, or when the network link between sites goes offline. This is specific to the two-site configuration where, without this designation, there would be no way for the system to determine which site should remain online in the event of a network separation (classically known in the clustering/distributed systems world as a "split-brain" system).

To set up this type of configuration:

1. Designate one of the sites as primary.
2. Start a majority of managers in the primary site.

Contact Customer Support for more information.

Failure modes and recovery steps

In general, there are three failure modes that a configuration like this can encounter that you should be aware of. "Failure conditions and resolutions" (page 18) summarizes the failure conditions and what you should do to rectify the issue.

Table 5 Failure conditions and resolutions

Failure condition	Resolution steps
Secondary site offline	None. The primary site will continue to operate.
Network link between sites fails	None. The primary site will continue to operate.
Primary site offline	1. If any of the storage systems running managers in the primary site can be brought back online, you should do this first. 2. If all storage systems in the primary site are lost forever, you can use the Recover Quorum command-line function to recover quorum in the secondary site manually. For more information, see "Recover quorum operation," next in this section

Recover quorum operation

The Recover Quorum function is introduced with the Multi-Site SAN as a way to bring volumes back online in the event that quorum in the management group is lost.

△ **CAUTION:** The Recover Quorum function should only be used as a last resort. The failed site must be completely failed to use Recover Quorum safely on the remaining site.

The Recover Quorum command-line function performs the following actions:

1. Removes all offline managers from the management group.
2. Ejects all offline storage systems from the management group.
3. The SAN/iQ software is modified to prevent any data integrity issues in the event any of the offline storage systems are brought back online.

Best practices for configuring quorum and managers in a Multi-Site SAN environment

Configuring the appropriate number of managers in a Multi-Site SAN on the appropriate storage systems is an important part of setting up the Multi-Site SAN for high availability and fault tolerance. "Common Multi-Site SAN configurations with recommended managers" (page 19) identifies common Multi-Site SAN configurations and the recommended manager configurations.

Table 6 Common Multi-Site SAN configurations with recommended managers

Multi-Site SAN configuration	Manager configuration	Number of managers and number Needed to maintain quorum
Two physical sites, one site is primary	For four storage systems, run: • two managers in the primary site • one manager in the secondary site For six storage systems or more, run: • three managers in the primary site • two managers in the secondary site	• Manager count = three Number for quorum = two • Manager count = five Number for quorum = three
Two physical sites, logical third site	For two storage systems, run: • one manager in each site • one failover manager in the logical third site • two managers in each site, one failover manager in the logical third site For four storage systems or more, run: • two managers in each site • one failover manager in the logical third site	• Manager count = three Number for quorum = two • Manager count = five Number for quorum = three
Three physical sites, cluster spans two sites	For two storage systems, run: • one manager in each site • one failover manager in the third site For four storage systems, run: • two managers in each site • one failover manager in the third site	• Manager count = three Number for quorum = two • Manager count = five Number for quorum = three
Three physical sites	For three storage systems, run: • one manager in each site For six or more storage systems, run: • two managers in each site	• Manager count = three Number for quorum = two • Manager count = six Number for quorum = four

2 Implementing a Multi-Site SAN

After you have designed the Multi-Site SAN configuration, you are ready to implement it.

Before you begin

Install Multi-Site SAN feature keys on the storage systems you are going to use.

Register your storage systems. For more information, see "Registering Advanced Features" in the *HP P4000 SAN Solution User Guide* for information about registering your storage systems.

Have the following information ready:

- The layout for storage systems and sites
- IP addresses, subnets, and VIPs to use for the Multi-Site cluster. You can use one VIP per subnet.
- (Optional) IP address and subnet for the Failover Manager

Preparing to install a new Multi-Site SAN

After you have finished planning the Multi-Site SAN and installed feature keys on the storage systems for the SAN, you are ready to begin installation.

Preparing to convert an existing SAN to a Multi-Site SAN

Converting an existing SAN to a Multi-Site SAN includes planning the site layout and network information along with the following considerations:

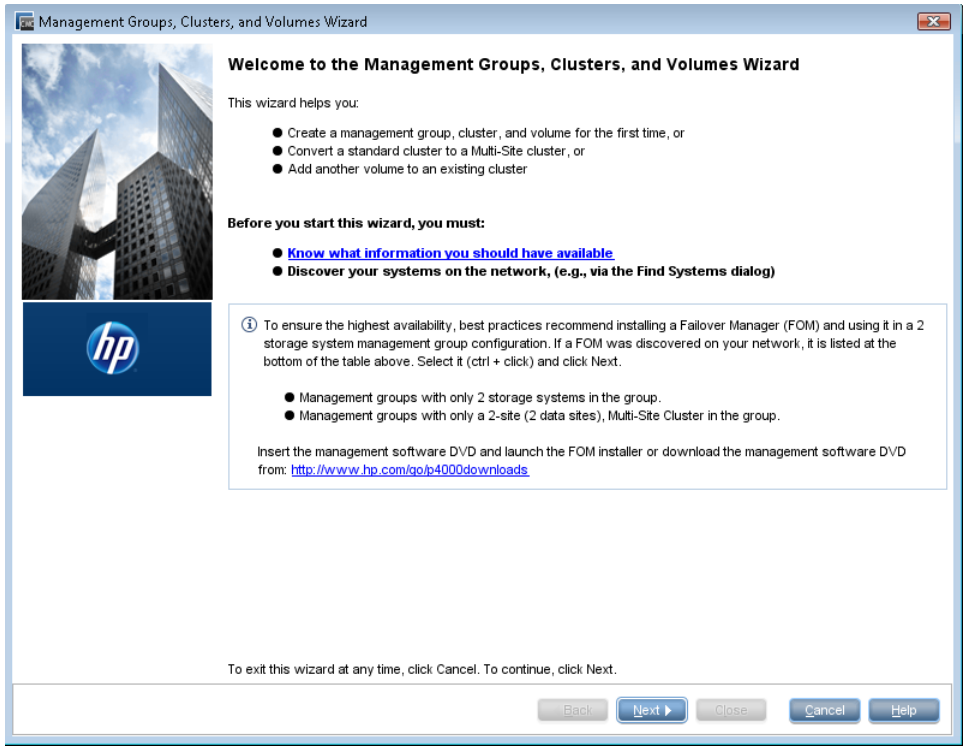
- Do you need to move/remove data from the existing SAN before reconfiguring it?
- Do you need to purchase additional storage systems to meet the requirement that each site have the same number of storage systems?
- Do you need to reconfigure your network to take advantage of the Multi-Site SAN capabilities?

  See "Designing the network for the Multi-Site SAN" (page 10) for detailed information about setting up your network appropriately.

Installing the Multi-Site SAN

To install a Multi-Site SAN, use the Management Groups, Clusters, and Volumes Wizard.

Figure 15 Using the management group wizard to create a Multi-Site SAN


Management Groups, Clusters, and Volumes Wizard
Welcome to the Management Groups, Clusters, and Volumes Wizard
This wizard helps you:
Create a management group, cluster, and volume for the first time, or
Convert a standard cluster to a Multi-Site cluster, or
Add another volume to an existing cluster
Before you start this wizard, you must:
Know what information you should have available
Discover your systems on the network, (e.g., via the Find Systems dialog)
To ensure the highest availability, best practices recommend installing a Failover Manager (FOM) and using it in a 2 storage system management group configuration. If a FOM was discovered on your network, it is listed at the bottom of the table above. Select it (ctrl + click) and click Next.
Management groups with only 2 storage systems in the group.
Management groups with only a 2-site (2 data sites), Multi-Site Cluster in the group.
Insert the management software DVD and launch the FOM installer or download the management software DVD from: http://www.hp.com/go/lp4000downloads
To exit this wizard at any time, click Cancel. To continue, click Next.
Back
Next
Close
Cancel
Help

NOTE: You must have at least one storage system for each site in the Available Systems pool before starting.

Creating the management group

The first part of the wizard creates the management group, which includes configuring the optimal number of managers for the initial setup. After you have the Multi-Site clusters configured, you need to review the manager configuration and adjust it according to the Multi-Site configuration you have planned. See "Configuring managers" (page 24).

Creating Multi-Site clusters and volumes

The path through the Multi-Site cluster portion of the wizard follows the steps listed below. The steps are described in greater detail in"Using the Multi-Site cluster wizard" (page 21).

1. Create a cluster.
2. Create a site and then assign storage systems to the site.
3. Create the additional sites with storage systems, up to a total of three sites.
4. Add one or more VIPs, depending on the number of subnets you have configured.
5. Create volumes using the data protection levels dictated by your Multi-Site cluster design.

Using the Multi-Site cluster wizard

After creating the management group, the Create a Cluster window of the wizard is displayed.

1. Select **Multi-Site Cluster** and then click **Next**.

   The Create Cluster window opens, displaying all of the storage systems you designated for the management group.
2. Select all the storage systems targeted for all of the sites you plan to create, type a name for the cluster, and then click **Next**.

Creating sites

When creating a new site, you first create the site and then assign storage systems to that site:

1. Click **New** to open the New Site window.
2. Enter a name for the site and an optional description.
3. [Optional] Make the site primary, if appropriate.
4. Click **Add** in the Site Systems section and then select the storage systems for this site.
5. Click **OK** when you have finished creating the site.

   The Set up Sites window opens, displaying the first site created and the remaining unassigned storage systems in the list.
6. Repeat these steps to create additional sites.
7. When you have finished creating sites, click **Next** to continue with the wizard.

   If you want to assign servers to a site, you can edit the site to do so.
8. Click **Add** to assign each VIP and Subnet Mask as planned for your site layout.

   NOTE: You can have one VIP per subnet.
9. Click **Next** to continue.
10. Click **Finish** when you have finished defining the volume.

    The management group, sites, Multi-Site cluster, and the volume are all created. This process takes some minutes.

Viewing the Multi-Site cluster information

You can view the completed sites and related information in two places. The Cluster tab view shows the sites in relation to the cluster.

- The Cluster tab view (Figure 16 (page 22)) which shows the sites.
- The Sites view (Figure 17 (page 23)) which shows detailed information about the storage systems in the cluster.

Figure 16 Viewing the sites in the cluster Details tab

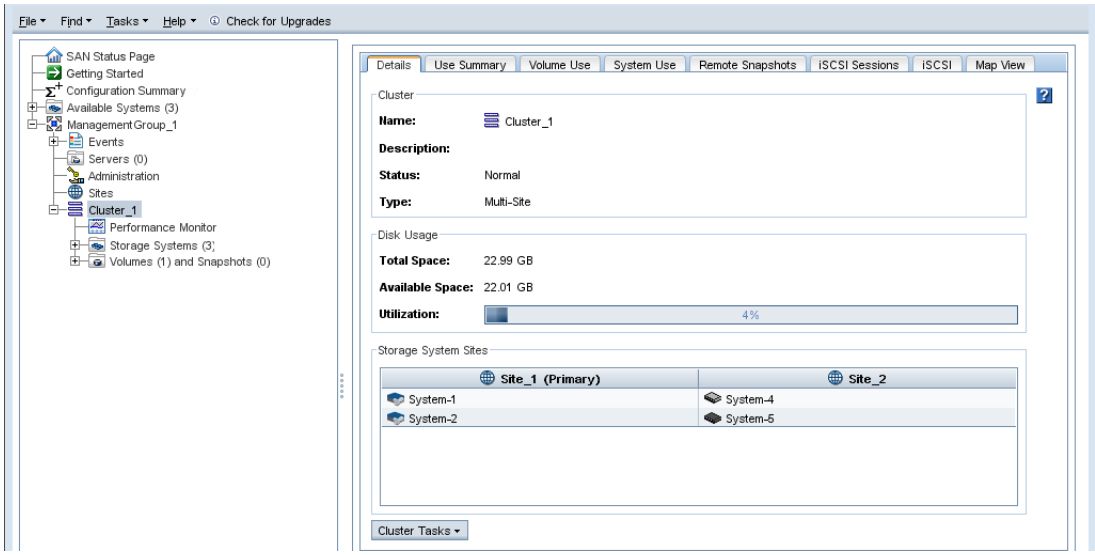
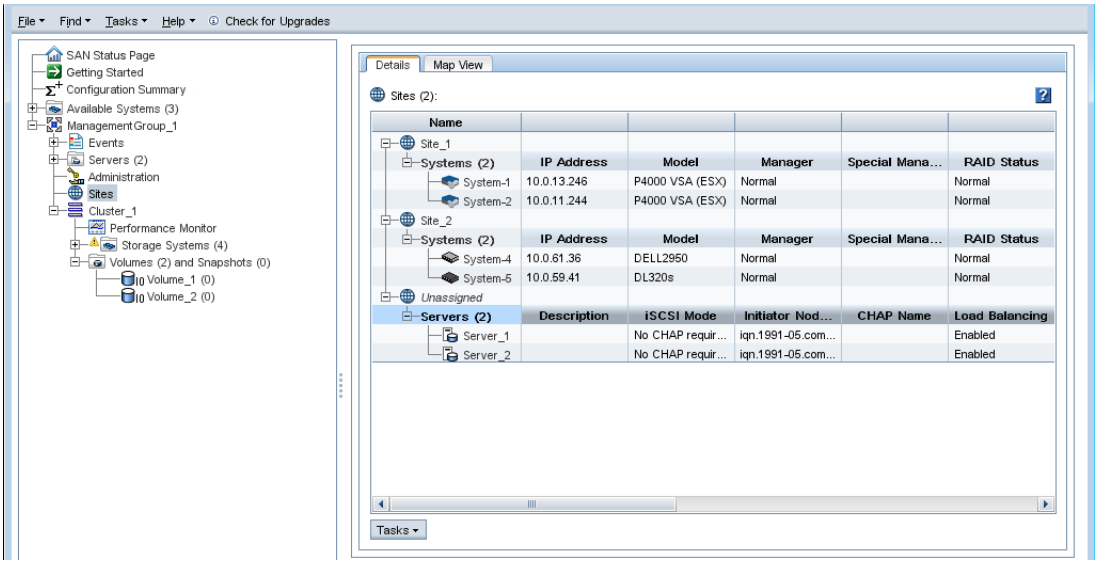


Figure 17 Viewing the Sites Details tab window



Converting an existing SAN to a Multi-Site SAN

Plan the conversion according to the criteria described in "Preparing to convert an existing SAN to a Multi-Site SAN" (page 20).

Prerequisites

- Upgrade all storage systems to SAN/iQ software version 7.0 or later.
- Obtain the feature keys for storage systems to be used in the Multi-Site cluster.
- Apply the feature keys to the storage systems.
- Add or remove storage systems to the cluster if necessary to ensure you can have equal numbers of storage systems in each site. The wizard will not let you create sites with different numbers of storage systems; nor will it let you leave unassigned any storage systems currently in the cluster.

Using the Multi-Site cluster wizard

Use the Management Groups, Clusters, and Volumes wizard to convert an existing standard cluster to a Multi-Site cluster.

1. Start the wizard from the Getting Started Launch Pad.
2. In the wizard, select **Existing Management Group** and then click **Next**.
3. Select the management group that contains the cluster you want to convert.
4. Click **Next** to open the Create a Cluster window.
5. Select **Existing Cluster** and **Convert a Standard Cluster to a Multi-Site Cluster** and then click **Next**.
6. Click **Next** to select a specific cluster.
7. Select the cluster you want to convert and then click **Next**.
8. Follow the steps in "Creating sites" (page 22) to create the sites using the listed storage systems.
9. After creating the sites, click **Next** The wizard opens the Assign Virtual IPs window.

   If the current cluster has a VIP assigned, it shows in this window. You can either use this VIP or assign new ones, according to the network plan for the Multi-Site cluster.

10. Assign one or more VIPs as planned for your site layout, and then click **Next**.

    The Create Volume window opens with the Skip Volume Creation box checked. If you want to create a new volume for your Multi-Site cluster, clear the box and fill in the volume information.

11. Click **Next** to complete the wizard.
12. Verify the settings for the sites you have just configured.
13. Click **Close** when you finish reviewing the Summary information.

    If you want to assign servers to the site, you can edit the site to do so.

14. Select the **Sites** node in the navigation window to view the new site configuration.

Configuring managers

After you have set up your management group, cluster, and sites, you may need to change the manager configuration of your Multi-Site SAN. You also need to add the Failover Manager in all but one type of configuration.

Overview

The SAN/iQ software automatically starts the regular manager on each storage system when creating a management group. The number of managers started depends on the number of storage systems in the group and whether you create a Multi-Site cluster. In some configurations, a Virtual Manager is also added to the management group. If, however, you plan to use a Failover Manager instead, you must manually install the Failover Manager on a separate server on the network and then add it to the management group as required by the design of your Multi-Site SAN. We recommend using the Failover Manager instead of the Virtual Manager because of its automated failover/failback capabilities.

Configuring regular managers

After you finish creating the management group, cluster, and sites for your Multi-Site SAN, review the manager configuration and change it as necessary. See "Common configurations of Multi-Site SANs and mangers" (page 7).

For information about management groups, managers, and starting and stopping managers, see the chapter "Working with Management Groups" in the *HP P4000 SAN Solution User Guide*.

Fault tolerant manager configurations

The SAN/iQ software tracks the configuration of managers to ensure that you have a fault-tolerant configuration. You may encounter messages with warnings or prerequisites you must meet before you can change the managers.

For example, if you create a management group and a Multi-Site cluster using two or four storage systems, the management group has regular managers running on each storage system plus a Virtual Manager added to the management group. If you want to add a Failover Manager or stop a manager on one of the storage systems, you must first delete the Virtual Manager from the management group. Then you can make the other changes.

Installing and configuring a Failover Manager

If you are using a Multi-Site SAN configuration that calls for a Failover Manager, you must install the Failover Manager from the SAN/iQ Management Software DVD onto a separate server on the network. The Failover Manager can run on VMware ESX Server, VMware Server, VMware Player, or Microsoft Hyper-V Server. For detailed instructions for installing and configuring the Failover Manager see "Using Specialized Managers" in the *HP P4000 SAN Solution User Guide*.

Best practice

Install the Failover Manager on a server in a separate physical location from the SAN sites, and then add it as a separate site in the management group. Doing so will prevent loss of quorum in a site failure, regardless of which single site fails.

Adding the Failover Manager to the management group and site

Adding the Failover Manager to the management group will likely cause the manager configuration to become less than optimal. Be sure to change the manager configuration to best reflect the new configuration of the management group. See the *HP P4000 SAN Solution User Guide*, Chapter 9, "Working with Management Groups," the section "Optimum Number of Managers."

1. Use **Find** to search for the Failover Manager, which appears in the Available Systems pool in the CMC.
2. Right-click on the **Failover Manager** and then select **Add to Existing Management Group**.
   - If there is more than one management group, select the correct one from the list that opens.
   - If there is only one management group, the Failover Manager is added to the group.
3. Select the **Sites** node in the navigation window.
4. Right-click and then select **New Site**.
5. In the New Site window, type the name and optional description for the Failover Manager site.
6. Click **Add** in the Site Systems section.
7. In the Add Systems to Sites window, select the **Failover Manager** from the list and then click **OK**.
8. Click **OK** on the New Site window.

   The new Failover Manager site appears in the Sites Details tab.

NOTE: You can also add the Failover Manager to an existing site.

Configuring sites

A site is a user-designated location in which storage systems are installed. Multi-Site SAN configurations have multiple sites with storage systems in each site. A site can be a logical configuration, such as a subnet within the same data center, department, or application. Volumes are replicated across sites, which ensures high availability and redundancy.

You can also assign application servers to sites to avoid high-latency connections. Application servers assigned to a specific site connect only to storage systems in the same site.

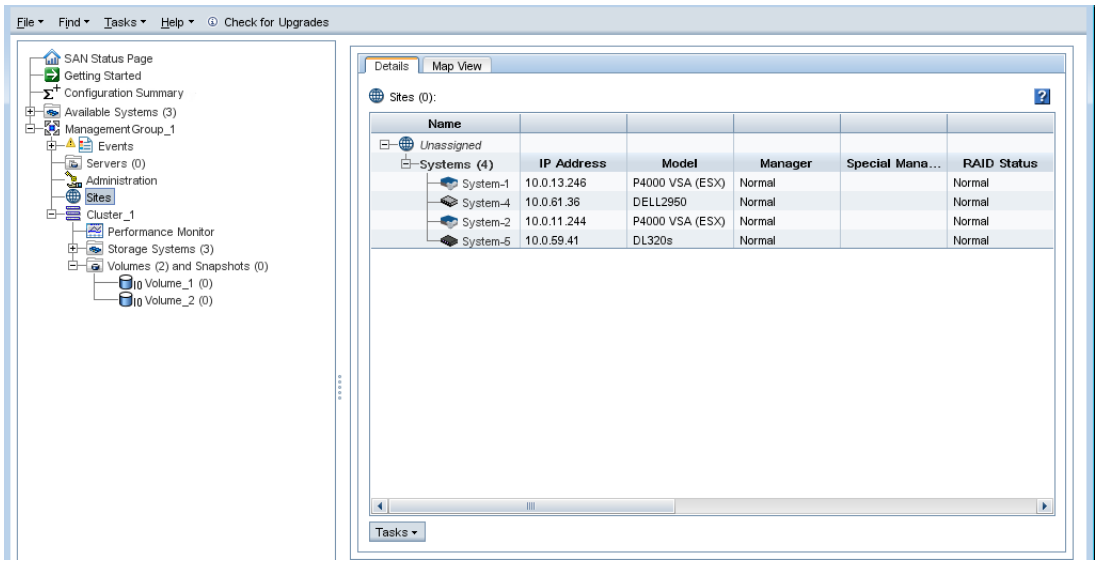
Sites have the following characteristics:

- Have equal numbers of storage systems, except for the Failover Manager, which can reside in a site by itself.
- Correlate to a geographical location and/or a configuration entity such as a subnet or power grid
- May be marked as primary
- Have a planned number of managers
- Have a planned data protection level
- Can have application servers assigned to them

Viewing sites in the CMC

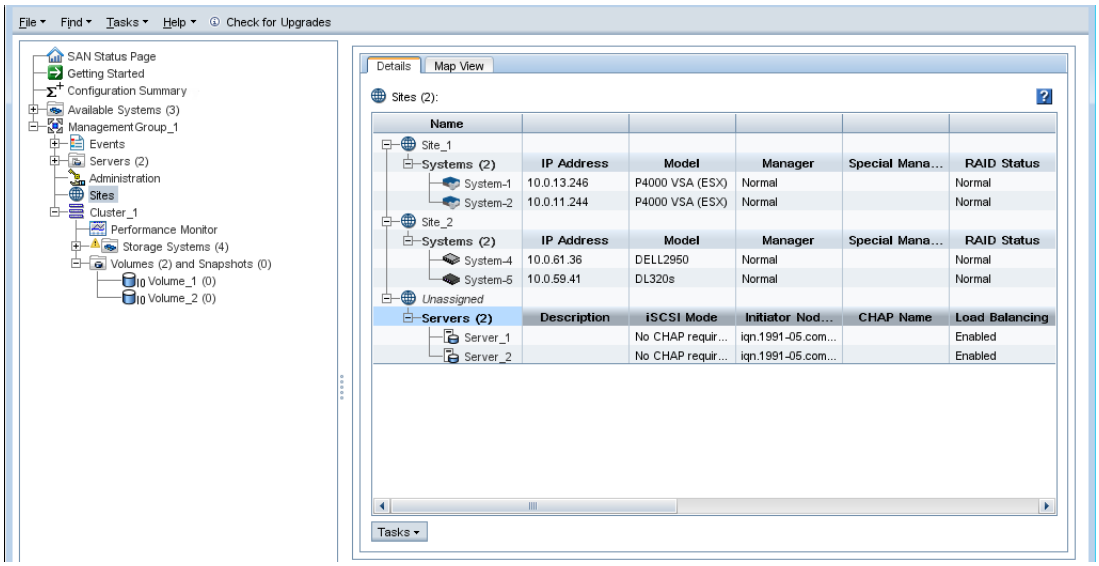
To view sites in the CMC, select the **Sites** node in the navigation window. The Sites node is displayed in every management group. Typically, however, the Sites Details tab shows the storage systems as unassigned. The site designation has no effect outside of the Multi-Site SAN configuration.

Figure 18 No sites in a standard cluster



When there is a Multi-Site cluster in the management group, the Sites Details tab shows the site assignments of the storage systems and servers.

Figure 19 Site assignments in a Multi-Site cluster



A management group can contain multiple clusters, some of which are Multi-Site and some of which are not. The Sites tab shows which clusters have sites and which do not (listed as Unassigned).

Sites map view

The Map View tab is useful for viewing the site assignments of the storage systems and servers. For more information on using the map view tools, see the *HP P4000 SAN Solution User Guide*.

Sites map views include the following:

- Sites
- Sites (Grouped)

Designating a primary site

Use the Primary designation when you are using the Multi-Site cluster to maintain a primary site and a second site as a backup site. Designate the site as Primary when you create the site, or you can edit an existing site to make it primary. Only one site can be designated as Primary in a Multi-Site cluster. Make sure that the majority of managers are in the Primary site.

Adding a site

Create new sites directly in the CMC if you want to add a site to an existing cluster. You must have equal numbers of storage systems in each site. The Failover Manager can occupy a site by itself.

1. Select the **Sites** node in the navigation window.
2. Right-click and then select **New Site**.
3. Type in a site name and optional description.
4. (Optional) If you are setting up a primary configuration, select the Primary box.
5. In the Site Systems section, click **Add** to add storage systems to the site.
6. Select the appropriate systems, and click **OK** when you are finished.
7. In the Site Servers section, click **Add** to add servers to the site.
8. Select the servers, and click **OK** when you are finished.
9. Click **OK** again when you have finished creating the new site.

   The Sites Details tab displays the new site with its storage systems and servers.

Editing a site

You can edit any aspect of the site, including:

- Changing the name and description of the site
- Changing the primary designation

  NOTE: Only one site can be primary.

- Adding or removing systems.

IMPORTANT: All sites must have the same number of storage systems, except for the Failover Manager, which can reside in a site by itself.

- Adding or removing servers.

To edit a site

1. Right-click the **Sites** node in the navigation window and then select **Edit Sites**.
2. Select the site you want to edit and then click **Continue**.
3. Make the desired changes.
4. Click **OK** when you are finished.

Deleting a site

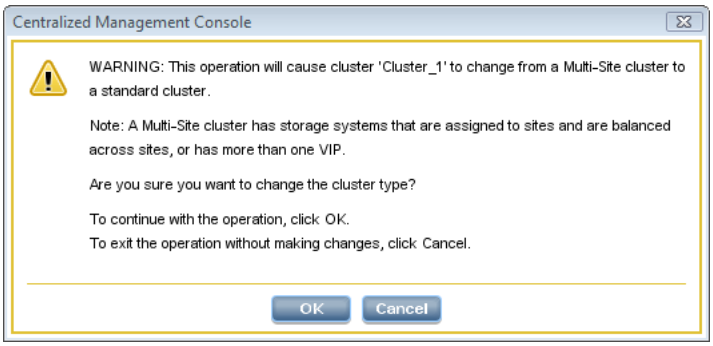
You would delete a site from a Multi-Site cluster when you are either reconfiguring your SAN or recovering from a disaster or other failure.

When only one site will be left in the cluster, deleting a site changes the cluster from a Multi-Site cluster to a standard cluster. If you then remove the storage system(s) assigned to that site, data that resides on the cluster will restripe.

1. Select the **Sites** node in the navigation window.
2. Select the site you want to delete in the Details tab, right-click, and then select **Delete Site**.

NOTE: If only one site will be left in the cluster, the warning shown in "Deleting a site that contains a storage system causes this warning" (page 28) is displayed.

Figure 20 Deleting a site that contains a storage system causes this warning


Centralized Management Console
WARNING: This operation will cause cluster 'Cluster_1' to change from a Multi-Site cluster to a standard cluster.
Note: A Multi-Site cluster has storage systems that are assigned to sites and are balanced across sites, or has more than one VIP.
Are you sure you want to change the cluster type?
To continue with the operation, click OK.
To exit the operation without making changes, click Cancel.
OK
Cancel

3. Click **OK** to delete the site.

Adding storage systems to a Multi-Site cluster

After your Multi-Site cluster is configured and operating, you may want to add storage systems to the cluster for additional capacity or to create a new site. While you can add storage systems to the Multi-Site cluster at any time, you should add them in a way that does not violate the requirements of the Multi-Site SAN.

See "Adding a site" (page 27) if you plan to add the storage systems to a new site in the cluster.

Adding additional capacity to existing sites

Plan the following items according to your overall Multi-Site SAN configuration:

- Plan to add the same number of storage systems to each site.
- Obtain feature keys for the new storage systems.
- Plan the IP addresses and locations for the new storage systems to fit into the overall design for your Multi-Site SAN.

To add capacity

1. Add the license keys to the new storage systems.

   See "Registering Advanced Features" in the *HP P4000 SAN Solution User Guide* for more information about license keys.
2. Add the new storage systems to the management group.
3. Select the management group **Sites** node in the navigation window.
4. Select the site to which you want to add a storage system.
5. Right-click and then select **Edit Site**.
6. In the Site Systems section, click **Add** to add the storage system.
7. Select the storage system from the list and then click **OK**.
8. Click **OK** to finish adding the storage system to the site.
9. Repeat these steps for all the storage systems you are adding.
10. Add the storage systems to the Multi-Site cluster, using the Edit Cluster window.

Removing storage systems from a Multi-Site cluster

Removing storage systems from a Multi-Site cluster affects the capacity of the cluster and the Multi-Site configuration.

- Ensure that the capacity remaining after you remove the storage system(s) is sufficient for the data on the volumes.
- To maintain the Multi-Site configuration, plan to remove equal numbers of storage systems from each site.

To remove the storage systems from the site

1. Select the **Sites** node in the navigation window.
2. Select the site from which you want to remove the storage system.
3. Right-click and then select **Edit Site**.
4. In the Site Systems section, select the storage system from the list and then click **Remove**.

   The storage system is removed from the list.
5. Click **OK** on the Edit Site window.

   A message opens, warning that the Multi-Site cluster will change to a standard cluster if you remove the storage system.
6. Click **OK** to continue.
7. Repeat these steps to remove storage systems from additional sites.

NOTE: Adding the Failover Manager will likely cause the manager configuration to become less than optimal. Be sure to change the manager configuration to best reflect the new configuration of the management group. See the section "Optimum Number of Managers" in the chapter, "Working with Management Groups" in the *HP P4000 SAN Solution User Guide*.

Removing servers from a site

You can remove servers from a site as server use and needs change.

To remove servers from a site:

1. Select the **Sites** node in the navigation window.
2. Select the site from which you want to remove the server.
3. Right-click and then select **Edit Site**.
4. In the Site Servers section, select the server from the list and then click **Remove**.

   The server is removed from the list.
5. Click **OK** on the Edit Site window.

   A message opens, warning that the server will lose its site preference.
6. Click **OK** to continue.

3 Support and other resources

Contacting HP

For worldwide technical support information, see the HP support website:

http://www.hp.com/support

Before contacting HP, collect the following information:

- Product model names and numbers
- Technical support registration number (if applicable)
- Product serial numbers
- Error messages
- Operating system type and revision level
- Detailed questions

Subscription service

HP recommends that you register your product at the Subscriber's Choice for Business website:

http://www.hp.com/go/e-updates

After registering, you will receive email notification of product enhancements, new driver versions, firmware updates, and other product resources.

HP Insight Remote Support Software

HP strongly recommends that you install HP Insight Remote Support software to complete the installation or upgrade of your product and to enable enhanced delivery of your HP Warranty, HP Care Pack Service or HP contractual support agreement. HP Insight Remote Support supplements your monitoring, 24x7 to ensure maximum system availability by providing intelligent event diagnosis, and automatic, secure submission of hardware event notifications to HP, which will initiate a fast and accurate resolution, based on your product's service level. Notifications may be sent to your authorized HP Channel Partner for on-site service, if configured and available in your country. The software is available in two variants:

- HP Insight Remote Support Standard: This software supports server and storage devices and is optimized for environments with 1-50 servers. Ideal for customers who can benefit from proactive notification, but do not need proactive service delivery and integration with a management platform.
- HP Insight Remote Support Advanced: This software provides comprehensive remote monitoring and proactive service support for nearly all HP servers, storage, network, and SAN environments, plus selected non-HP servers that have a support obligation with HP. It is integrated with HP Systems Insight Manager. A dedicated server is recommended to host both HP Systems Insight Manager and HP Insight Remote Support Advanced.

Details for both versions are available at: http://h18004.www1.hp.com/products/servers/management/insight-remote-support/overview.html

To download the software, go to Software Depot:

https://h20392.www2.hp.com/portal/swdepot/index.do.

Select Insight Remote Support from the menu on the right.

New and changed information in this edition

The following additions and changes have been made for this edition:

- The following information has been updated:
  - P4000 SAN Solution software and user manuals have been rebranded
- Functionality has been added that allows adding servers to sites.

Related information

The following documents [and websites] provide related information:

- *HP P4000 SAN Solution User Guide*

You can find these documents from the Manuals page of the HP Business Support Center website:

http://www.hp.com/support/manuals

In the Storage section, select **Disk Storage Systems** and then select **P4000 G2 SAN Solutions**.

HP websites

For additional information, see the following HP websites:

- http://www.hp.com
- http://www.hp.com/go/storage
- http://www.hp.com/service_locator
- http://www.hp.com/support/manuals
- http://www.hp.com/support/downloads

Glossary

The following glossary provides definitions of terms used in the SAN/iQ software and the HP P4000 SAN Solution.

acting primary volume — The remote volume, when it assumes the role of the primary volume in a failover scenario.

Active-Passive — A type of network bonding which, in the event of a NIC failure, causes the logical interface to use another NIC in the bond until the preferred NIC resumes operation. At that point, data transfer resumes on the preferred NIC.

Adaptive Load Balancing — A type of network bonding in which the logical interface performs load balancing of data transmission.

application-managed snapshot — Snapshot of a volume that is taken while the application that is serving that volume is quiesced. Because the application is quiesced, the data in the snapshot is consistent with the application's view of the data. That is, no data was in flight or cached waiting to be written.

authentication group — For release 7.0 and earlier, identifies the client or entity accessing the volume. Not used in release 8.0 and later.

Auto Discover — A feature in the CMC that automatically searches for storage systems on the subnet the CMC is connected to. Any storage systems it discovers appear in the navigation window on the left side of the CMC.

Bond0 — Interface created for network interface failover and only appears after configuring for failover.

bonding — Combining physical network interfaces into a single logical interface.

boot device — Compact flash cards from which the storage system boots up. Also known as disk-on-modules or DOMs.

CHAP — Challenge-Handshake authentication protocol.

CLI — Command-line interface. An interface comprised of various commands which are used to control operating system responses.

clone point — The snapshot that has two or more volumes related to it. A clone point is created when a SmartClone volume is created from a snapshot or from snapshot temporary space.

cluster — A cluster is a grouping of storage systems that create the storage pool from which you create volumes.

CMC — Centralized Management Console. See HP P4000 Centralized Management Console.

communication mode — The unicast communication among storage systems and application servers.

community string — The community string acts as an authentication password. It identifies hosts that are allowed read-only access to the SNMP data.

Configuration Summary — The Configuration Summary displays an overview of the volumes, snapshots, storage systems, and iSCSI sessions in the HP P4000 SAN Solution. It provides an overview of the storage network broken out by management groups.

data center — Also known as a "Site." A data center is a physical location in your environment where application servers, SAN storage and network equipment reside. In the SAN/iQ Multi-Site software, a data center is typically referred to as a site.

disaster recovery site — Similar to a secondary site, the disaster recovery site is used to operate the SAN in the event of a disaster.

disk status — Whether the disk is:

- Active - on and participating in RAID
- Uninitialized or Inactive - On but not participating in RAID
- Off or Missing - Not on
- DMA Off - disk unavailable due to faulty hardware or improperly seated in the chassis

DSM	Device Specific Module.
DSM for MPIO	The HP P4000 DSM for MPIO vendor-specific DSM that interfaces with the Microsoft MPIO framework.
failback	After failover, the process by which you restore the primary volume and turn the acting primary back into a remote volume.
failover	The process by which the user transfers operation of the application server over to the remote volume. This can be a manual operation, a scripted operation, or VMware enabled.
Failover Manager	A specialized manager running as a VMware appliance that allows you to place a quorum tie-breaker system into a 3rd location in the network to provide for automated failover/failback of the Multi-Site SAN clusters. The Failover Manager is designed to run on VMware ESX Server, VMware Server, and VMware Player. It is installed on hardware separate from the SAN hardware.
failover recovery	After failover, the process by which the user chooses to fail back to the primary volume or to make the acting primary into a permanent primary volume.
frame size	The frame size specifies the size of data packets that are transferred over the network.
full provisioning	Full provisioning reserves the same amount of space on the SAN as is presented to application servers.
ghost storage system	When using Repair Storage System, a "ghost" storage system acts as a placeholder in the cluster, keeping the cluster intact, while you repair or replace the storage system.
Graphical Legend	Describes all the icons used in the CMC: • Items tab - displays the icons used to represent virtual items displayed in the CMC • Hardware tab - displays the icons that represent the physical storage units.
hardware reports	Hardware reports display point-in-time statistics about the performance and health of the storage system, its drives, and configuration.
hostname	The hostname on a storage system is the user-definable name that displays below the storage system icon in the network window. It is also visible when the users browse the network.
HP P4000 Centralized Management Console	Management interface for the SAN/iQ software.
ID LED	LED lights on the physical storage system so that you can find that system in a rack.
iSCSI	Internet small computer system interface. Like an ordinary SCSI interface, iSCSI is standards-based and efficiently transmits block-level data between a host computer (such as a server that hosts Exchange or SQL Server) and a target device (such as the HP All-in-One Storage System). By carrying SCSI commands over IP networks, iSCSI is used to facilitate data transfers over intranets and to manage storage over long distances.
iSCSI load balancing	Improves iSCSI performance and scalability by distributing iSCSI sessions for different volumes evenly across storage systems in a cluster.
license key	A WWN-encoded sequence that is obtained from the license key fulfillment website.
Link Aggregation Dynamic Mode	A type of network bonding in which the logical interface uses both NICs simultaneously for data transfer.
log files	Log files for the storage system are stored both locally on the storage system and are also written to a remote log server.
logical site	This site is on an isolated network and power connection than the other sites. However, it can be in the same physical location as one of the real sites. Also, a site for a Failover Manager.
management group	A collection of one or more storage systems which serves as the container within which you cluster storage systems and create volumes for storage.
managers	Manager software runs on storage systems within a management group. You start managers on designated storage systems to govern the activity of all of the storage systems in the group.
MIB	Management information base. A database of managed objects accessed by network management protocols. An SNMP MIB is a set of parameters that an SNMP management station can query or set in the SNMP agent of a network device (for example, a router).

Multi-Site cluster A cluster of storage that spans multiple sites (up to three). A Multi-Site cluster must meet at least one of the following conditions:

- Contain storage systems that reside in two or more sites
- Contain storage systems that span subnets
- Contain multiple VIPs. The cluster can have a single site, and the multiple VIPs make it a multi-site cluster.

network RAID Synchronous replication, mirroring or parity protection on a volume-by-volume basis. Protecting data for a volume across all storage systems in the cluster. Network RAID-10, 10+1 or 10+2 is required to protect data in an HP P4000 SAN solution.

network window Graphically depicts the status of each storage system. Storage systems on the network are either available or part of a management group.

NTP Network Time Protocol

original primary volume The primary volume that fails and then is returned to service.

overprovisioned cluster An overprovisioned cluster occurs when the total provisioned space of all volumes and snapshots is greater than the physical space available on the cluster. This can occur when there are snapshot schedules and/or thinly provisioned volumes related to the cluster.

parity In RAID 5, redundant information is stored as parity distributed across the disks. Parity allows the storage system to use more disk capacity for data storage.

peer site Absence of a primary site designation makes all the sites peer sites.

point-in-time snapshot Snapshots that are taken at a specific point in time, but an application writing to that volume may not be quiesced. Thus, data may be in flight or cached and the actual data on the volume may not be consistent with the application's view of the data.

preferred interface A preferred interface is the interface within an active backup bond that is used for data transfer during normal operation.

primary site A site designation assigned by the administrator in the HP P4000 Centralized Management Console. A primary site is more important than a secondary site. In this setup, you would run a majority of managers in the primary site. In a two-site setup, this allows the primary site to stay online even if the network link between the primary and secondary sites fails. Typically, the primary site has majority/all of the application servers. In configurations that do not designate a primary site, the sites are referred to as “peer” sites.

primary snapshot A snapshot of the primary volume which is created in the process of creating a remote snapshot. The primary snapshot is located on the same cluster as the primary volume.

primary volume The volume which is being accessed (read/write) by the application server. The primary volume is the volume that is backed up with Remote Copy.

quorum A majority of managers required to be running and communicating with each other in order for the SAN/iQ software to function.

RAID device RAID (originally redundant array of inexpensive disks, now redundant array of independent disks) refers to a data storage scheme using multiple hard drives to share or replicate data among the drives.

RAID levels Type of RAID configuration:

- RAID 0 - data striped across disk set
- RAID 1 - data mirrored from one disk onto a second disk
- RAID 10 - mirrored sets of RAID 1 disks
- RAID 5 - data blocks are distributed across all disks in a RAID set. Redundant information is stored as parity distributed across the disks.
- RAID 50 - mirrored sets of RAID 5 disks.

RAID quorum Number of intact disks required to maintain data integrity in a RAID set.

RAID rebuild rate The rate at which the RAID configuration rebuilds if a disk is replaced.

RAID status Condition of RAID on the storage system:

- Normal - RAID is synchronized and running. No action is required.
- Rebuild - A new disk has been inserted in a drive bay and RAID is currently rebuilding. No action is required.
- Degraded - RAID is not functioning properly. Either a disk needs to be replaced or a replacement disk has been inserted in a drive.
- Off - Data cannot be stored on the storage system. The storage system is offline and flashes red in the network window.

register Register individual storage systems to use add-on applications. Registration requires sending in the storage system serial numbers to purchase the license keys, which are then applied to the storage system.

remote copy pair The primary volume and its related remote volume.

remote snapshot An identical copy of a primary snapshot. The remote snapshot is located on the same cluster as the remote volume.

remote volume The volume that resides in the Remote Copy location where the remote snapshots are created. The remote volume contains no data. It acts as a pointer to tell the system where to make the copy of the primary snapshot. The remote volume can be stored in these ways:

- In the same cluster in the same management group
- In a different cluster in a different management group
- In a different cluster in the same management group

Repair storage system Creates a placeholder in the cluster, in the form of a "ghost" storage system, that keeps the cluster intact while you remove the storage system to replace a disk or replace the storage system itself, and return it to the cluster.

replication level In Release 8.5 this changes to data protection level. Prior to release 8.5, replication level is the term that designated how many copies of data to keep in the cluster.

replication priority Removed in Release 8.5. Prior to Release 8.5, replication priority allowed you to designate whether data availability or redundancy is more important in your configuration. Release 8.5 forward defaults to availability. This default can be changed using the Cliq Command Line Interface.

restripe Striped data is stored across all disks in the cluster. You might change the configuration of a volume, for example, change data protection level, add a storage system, or remove a storage system. Because of your change, the pages in the volume must be reorganized across the new configuration. The system can keep track of several configuration changes at once. This means you can change configurations, even while a volume is in the midst of a different reconfiguration. In particular, if a reconfiguration was done by accident, you don't have to wait until it finishes to change back to the original configuration. See "Stripe".

resync When a storage system goes down, and writes continue to a second storage system, and the original store comes back up, the original storage system needs to recoup the exact data captured by the second storage system.

rolling back Replaces the original volume with a read/write copy of a selected snapshot. Starting with release 8.0, he new volume retains the same name.

SAN/iQ interface When you initially set up a storage system using the Configuration Interface, the first interface that you configure becomes the interface used for the SAN/iQ software communication.

secondary site A site that is less important than the primary site. In this setup a minority of managers runs in the secondary site. In a two-site setup, this allows the secondary site to go offline if the network link between the Primary and secondary sites fails. Typically, the secondary site has a minority, or none, of the application servers. If the primary site fails, customers can manually recover quorum in the secondary site.

server An application server that you set up in a management group and then assign volumes to it to provide access to those volumes.

shared snapshot	Shared snapshots occur when a clone point is created from a newer snapshot that has older snapshots below it in the tree. All the volumes created from the clone point will display these older snapshots that they share, as well as the clone point.
site	A user-designated location in which storage systems are installed. Multi-Site SAN configurations have multiple sites with storage systems in each site, and each site has its own subnet. A site can be a logical configuration, such as a subnet within the same data center, department, or application.
SmartClone volume	SmartClone volumes are space-efficient copies of existing volumes or snapshots. They appear as multiple volumes that share a common snapshot, called a clone point. They share this snapshot data on the SAN.
snapshot set	Application-managed snapshots created for a volume set.
snapshot	A fixed version of a volume for use with backup and other applications.
SNMP traps	Use traps to have an SNMP tool send alerts when a monitoring threshold is reached.
solution pack	HP P4000 Windows Solution Pack
split mirror	A full copy of data that has been split off from the original and is no longer being updated.
standard cluster	Also known as a "cluster." A standard cluster is one that does not use any of the Multi-Site features within the SAN/iQ software. Standard clusters: • Cannot contain storage systems that are designated to reside in a site. • Cannot contain storage systems that span subnets. • Can only have a single VIP.
storage server	Storage server software maintains the customer's data. It reads to and writes from disks in response to customer reads and writes of SANiQ volumes.
stripe	Striped data is stored across all disks in the array, which increases performance but does not provide fault tolerance.
synchronize	The process of copying the most recent snapshot from the primary volume to a new remote snapshot. On failback, synchronization is the process of copying the most recent remote snapshot back to the primary volume. The CMC displays the progress of this synchronization. Also, you can manually synchronize if necessary to include data that is on the remote volume but not the primary.
target secret	Target secret is used in both 1-way and 2-way CHAP when the target (volume) challenges the iSCSI initiator.
temporary space	Temporary space is created when a snapshot is mounted for use by applications and operating systems that need to write to the snapshot when they access it. Temporary space can be converted to a volume using the SmartClone process.
thin provisioning	Thin provisioning reserves less space on the SAN than is presented to application servers.
trap	A type of SNMP message used to signal that an event has occurred. (SNIA)
Trap Community String	The Trap Community String is used for client-side authentication when using SNMP.
unicast	Communication between a single sender and a single receiver over a network.
VIP	virtual IP address
virtual IP address	A highly available address that ensures that if a storage system in a cluster becomes unavailable, servers can still access the volume through the other storage systems in the cluster.
virtual machine	A virtual storage appliance that provides one or more simultaneous storage environments in which SAN/iQ may execute as though they were running on the bare iron.
virtual manager	A manager that is added to a management group but is not started on a storage system until it is needed to regain quorum.
volume	A logical entity that is made up of storage on one or more storage systems. It can be used as raw data storage or it can be formatted with a file system and used by a host or file server.
volume lists	For release 7.0 and earlier, provide the link between designated volumes and the authentication groups that can access those volumes. Not used in release 8.0 and later.

volume set	Two or more volumes used by an application. For example, you may set up Exchange to use two volumes to support a StorageGroup: one for mailbox data and one for logs. Those two volumes make a volume set.
volume size	The size of the virtual device communicated to the operating system and the applications.
VSS Provider	HP P4000 VSS Provider is the hardware provider that supports the Volume Shadow Copy Service on the HP P4000 SAN Solution.
VSS	Volume Shadow Copy Service
writable space	*See* temporary space .

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